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Botanicals as part of an integral value-added pork production system

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Abstract: *Selected herbs are known to naturally possess antibacterial and other characteristics that could be useful in animal protein production. Inclusion of these herbs in animal feeds as alternative growth promotion and efficiency stimulants may be able to address some of the current concerns about the possibility of significant antibiotic-resistant bacteria development that stems from drugs currently used at subtherapeutic levels in animal production. Several herbs were tested for their ability to aid animal growth rates and feed efficiency without giving rise to antibiotic-resistant microbes.*

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Budget:
$24,950 for one year

Background

The historic use of herbal remedies to control diseases and promote growth has been supplanted with the emergence of specific manufactured chemotherapeutic and antibacterial agents that are low-cost and readily available. The 1995 National Animal Health Monitoring Systems survey reported that 96 percent of all swine received growth promotant products during their lifetime. Now the possibility of significant antibiotic-resistant bacteria development through the use of these human drugs in animals, and subsequent transfer of this resistance to human pathogens, has raised concerns in the medical community.

There was need for a study of the use of certain herbs to promote growth rate and feed efficiency in feeder swine while averting the possibility of creating antibiotic resistance. Garlic, *Echinacea*, and goldenseal possess known antibacterial qualities, while peppermint has effects that may aid the digestive process. These four botanical prospects were selected for inclusion in swine feeds based on their pharmacological properties and agronomic characteristics.

The four selected herbs are capable of being grown effectively in Iowa with minimal capital investment and appear to be unaffected by common agronomic pests. This would allow Iowa swine producers to grow their own natural growth promotants for inclusion in swine diets. These herbs also have the potential for flavoring the meat of treated swine to produce a distinctive value-added product.

Echinacea spp., or purple cornflower, a perennial herb capable of growth throughout the midwestern United States, is purported to possess antibacterial activity, immuno-enhancing properties, and viral inhibition characteristics under some conditions. There are nine species of *Echinacea*, but only three are commonly used for medicinal purposes. The whole plant, including the aerial portions and tap roots, has been used for medicinal preparations.

Garlic, a member of the lily family and a perennial plant, is cultivated worldwide. Garlic bulbs, either fresh or dehydrated, may be used for medical purposes and have demonstrated broad-spectrum antimicrobial activity against many bacteria, viruses, parasites, and fungi. Garlic inclusion rates of 2 to 4 percent in feeds had a protective effect on chickens subjected to experimental candidiases (fungi). Feed containing 5 percent garlic eliminated candida (fungal) infection.

Goldenseal, known to possess antibacterial properties, is a perennial native to eastern North America that can be grown in Iowa. Its most pharmacologically active alkaloid, berberine, is concentrated in the rhizome and roots. Its antimicrobial activity has been dem-

onstrated against a wide range of bacteria, protozoa, and fungi. Berberine has demonstrated a capability to inhibit adherence of group A streptococci to host cells and proven effective in the treatment of acute diarrheal diseases caused by *E. coli* and *Salmonella*. The effective dosage for goldenseal should be based on berberine content.

Peppermint grows under a wide range of conditions; black and white peppermint are the two most popular varieties. The major medical component of peppermint is the volatile oils found predominantly in the aerial portions of the plant. Peppermint and other members of the mint family have demonstrated significant antiviral capability, as well as antimicrobial activity against streptococcus and staphylococcus. Treatment dosages are not well- established in humans and limited data are available for animals.

Approach and methods

Several portions of the experiment were similar for all four botanicals tested. All the experiments were conducted at the ISU Swine Nutrition and Management Center in a temperature-regulated nursery room and lasted four to five weeks. Pigs were weaned at 21 days (average weight of 12.7 lb) and immediately placed on the experimental diets. They were grown in 4 x 4 ft raised deck pens with heat pads, self-feeders, and nipple waterers. Pigs were allotted at random to blocks of pens on the basis of initial weight and litter. There were usually 20 pens of four or five pigs each, providing four replications of five dietary treatments. Each pen of pigs was given the prestarter treatment feed and then was switched to the starter treatment diet for the remainder of the study. The control diet contained 50 g of Mecadox per tn and other treatments offered the same diet without the Mecadox. Pigs were weighed and feed disappearance was determined weekly. One pig from each of the treatments was taken to the ISU Meat Laboratory, slaughtered, and various muscles were evaluated for sensory and quality characteristics.

Pigs were grown on wire floors in pens with a heating pad and stainless steel feeder

Echinacea Experiments began in January 1998, with 100 pigs grouped in 20 pens of five pigs. Each pen of five pigs received approximately 16 lb of the prestarter treatments and then was switched to the starter treatment. Increasing levels of Echinacea (0.0, 0.1, 0.5, and 2.0 percent) replaced equivalent weights of corn in the diet.

Garlic The testing started in October 1997 on 80 pigs. The 20 pens of four pigs each were fed 63 lb of the prestarter treatments before changing to the starter diet. Increasing levels of garlic powder (0.0., 0.5, 2.5, and 5.0 percent) replaced equivalent weights of corn in the diet. The 0 percent garlic was considered to be the negative control.

Goldenseal Starting in March 1998, 80 pigs were tested and fed 63 lb of prestarter before beginning the starter treatment. Increasing levels of goldenseal (0.0, 0.1, 0.5, and 2.0 percent) replaced equivalent weights of corn in the diet. The goldenseal was analyzed and contained 2.8 percent berberine.

Peppermint Ninety-five pigs were evaluated starting in July 1998. Fifteen pens of five pigs each and five pens of four pigs each provided

four replications of five dietary treatments. Two replicates were started on July 16, 1998, and two on July 23, with each pig receiving approximately 12.75 lb of their respective prestarter. Increasing levels of peppermint (0.0., 0.50, 2.50, and 5.0 percent) replaced equivalent weights of corn in the diet.

Nursery room of 20 pens with electronic scale in the foreground at ISU Swine Nutrition and Management Research Farm

Results and discussion

Echinacea No pigs died or were removed from the study. The first week there were no statistical performance differences among the treatments. In the 0-to 2-week period, the 0 percent Echinacea treatment group required significantly more feed than the other treatments, but daily gain and feed intake were not statistically different. In weeks 0 to 3 and 0 to 4, the two high levels of Echinacea were significantly more successful in feed efficiency, but daily gain and feed intake were not significantly different. Total performance for the entire five-week experiment was not statistically different from the control.

Garlic Two pigs, both on the 2.5 percent garlic diet, died in the first and fourth weeks of the experiment. One observation was that the room and adjacent hallway had a very strong, objectionable odor of garlic combined with hog manure throughout the entire study.

The overall summary for five weeks indicated the control diet with Mecadox significantly improved the daily gain compared with the garlic treatments. Generally, the higher the level of garlic, the poorer the daily gain. Overall feed efficiency was best for 0 percent garlic (negative control), but was statistically different only when compared with the 2.5 percent garlic treatment. The highest level of garlic significantly reduced feed intake in weeks two, three, and five compared with the control diet.

Average pH values increased and cooking losses decreased with added garlic. All pigs sampled had strong off-flavors, increasing as the garlic levels increased.

Goldenseal No pigs died or were removed from the study. Additions of goldenseal produced performance comparable with the Mecadox control during the first week. By the second week, the control diet average daily gain was significantly greater than the three higher levels of goldenseal. Control diet average daily feed intake tended to be greater than the goldenseal diets. The third and fourth weeks found significantly greater gains and feed intake for the control pigs over all other treatments. The feed intake for the two highest levels of goldenseal tended to be greater than the 0.0 negative control. Overall feed intake was highest for the control diet. Overall feed efficiency was the lowest for the control diet when compared with the 0.0 and 0.5 percent treatments, but was not statistically different from the two highest levels.

Peppermint No pigs died or were removed from the study. Pigs on all treatments, including the positive and negative control pigs, performed similarly over the entire experimental period. A statistically significant response to incremental increases in peppermint was not observed.

For the first two weeks, the 0 percent negative control pigs required significantly more feed than both the control and the 2.5 percent peppermint pigs. Generally, the positive control

John Simonson and Dan Johnson weighing nursery pigs at the end of the test

pigs and the added peppermint pigs performed similarly during this period. During the second two weeks, the 0.5 percent peppermint pigs consumed more feed than the 0 percent pigs in week 3 and both the 0 and 2.5 percent pigs in week 4. No statistical differences were observed in the overall data. Muscle tests after slaughter indicated that not much flavor was present in these young pigs, with very little difference between the peppermint levels and the control diets.

Impact of results

Echinacea These data suggest that higher levels of Echinacea enhanced pig feed efficiency compared to the 0 percent Echinacea during the first two weeks and were greater than the positive control diet with Medacox during the third and fourth weeks. Overall, performance was similar for all treatments, suggesting minimal stress during this experiment. Echinacea appears to offer performance enhancement and may be able to provide antimicrobial protection for nursery pigs, especially during the first four weeks after weaning. Generally, all three inclusion levels performed similarly. As Echinacea has a very mild aroma, meat flavors were all within an acceptable range.

Garlic Garlic at the levels fed in this study tended to depress feed intake and performance as the experiment progressed. The first week, pigs fed lower levels of garlic performed similarly to the positive control. Overall the highest level of garlic had a feed efficiency similar to the positive control (medicated with carbadox). All treatments, including those without the garlic, resulted in objectionable flavors in the meat, possibly as a result of the strong garlic odor in the room. It is likely that by the time the pigs would have reached market size, after 16 weeks of no garlic exposure, the muscle flavor would not be affected.

Goldenseal Goldenseal at the two higher levels appears to enhance feed efficiency over the 0.05 percent level during the first three- and four-week periods. Overall, growth rate and feed efficiency responses appear to be minimal. At present, we would not continue to evaluate goldenseal for this purpose because of product expense and a lack of potential effectiveness.

Peppermint Nursery pigs fed different levels of peppermint had varied responses. During the first two weeks, pigs fed peppermint had somewhat improved feed efficiency over the negative control and were competitive with the positive control diet. Feed intake also appeared to be improved. As with other trials, the negative control pigs performed similarly to the positive control pigs, indicating that the health status of the pigs was quite high, or the stress levels were quite low. This situation confounds analysis of the results. However, the early peppermint inclusion performance justifies additional study.

Education and outreach

Four publications on the results of the four botanical tests were included in the 1998 Iowa State University Swine Research Report.

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